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The Coast Guard Engineer's Digest

U.S. Department
of Transportation

United States
Coast Guard



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The Coast Guard Engineer's Digest

United States
Department of Transportation
CG-133

Chief, Office of Engineering
RADM K. G. Wiman
Deputy Chief, Office of Engineering
CAPT D. L. Hoffer
Editor
Annette M. Nieves

The Coast Guard **Engineer's Digest** is an official publication of the Office of Engineering, U.S. Coast Guard Headquarters, Washington, D.C. Now published quarterly, the **Digest** has been a medium for communicating new ideas and technology of interest to Coast Guard engineers since April 1933.

The **Digest** is a professional journal for the publication of general interest articles and studies aimed at sharing lessons learned and advancing engineering in the Coast Guard. Articles will be published based upon their audience in the general readership, the appropriate reviewer's recommendation, the timeliness, and the quantity and types of articles available.

While some material for the **Digest** is reprinted from other technical publications, most papers are submitted from the field by Coast Guard engineers and engineering managers, both military and civilian.

The Office of Engineering encourages all Coast Guard personnel in engineering-related fields to share their ideas, experiences, successes, and failures with the Coast Guard engineering community by submitting articles and papers for publication in the **Digest**.

Observe the following guidelines when submitting material for publication:

- Manuscripts should be typed double spaced on one side of 8½ x 11-inch white paper, leaving at least a 1-inch margin on all sides.
- Original articles by Coast Guard personnel (civilian and military) should have a byline, giving name, title, and unit, and a short biography of the author.
- Illustrations—glossy black and white photographs or line drawings—should be approximately 8 x 10 inches in size. In cases

where the author does not have adequate facilities for producing finished art, the **Digest** can have artwork made up from the sketches.

- Complete figure captions and figure numbers should be listed on a separate sheet of paper or taped to the back of each illustration. Do not use staples or paper clips on photographs. Protect illustrations for mailing by placing them between pieces of stiff cardboard.

Send articles (original and one copy), letters, photographs, suggestions, etc., to:

Editor, **Engineer's Digest** (G-Eg/62)
U.S. Coast Guard Headquarters
2100 Second Street, S.W.
Washington, DC 20593

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The **Engineer's Digest** is compiled in the Office of Engineering, U.S. Coast Guard Headquarters, and is printed by the Government Printing Office. No advertising is permitted, and no subscriptions are available. Individual issues may be requested from the editor.

The contents of the **Engineer's Digest** are for information only and should not be construed as altering or superseding official regulations, orders, or directives. The ideas and opinions expressed are those of the individual authors and should not be considered to be the official views of the Commandant.

This publication is intended for all hands. Commanding Officers should take the necessary steps to make it available to all military and civilian personnel within their commands.

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Table of Contents

Volume 24
Number 231
Fall 1986

Features	HH-65A Snow and Ice Operational Capability: The 1986 Ottawa Snow and Ice Testing	13
	CAPT Sperry C. Storm	
	Applying Thermography to the Insulation Industry	20
	Mr. Walter Baumann	
	Fifth R&D Reader's Digest, Part II	23
	CDR R. J. Davison	
Departments	From the Editor	2
	Engineering News	3

From the Editor

Dear Readers:

Now that the vacation season (the time to pack up and head for the hills, and the beach, and the Big City, and Grandma's, and wherever else your vacation fancy takes you) is over, it is time to move forward into the fall.

The fall season bears a special significance in my mind for it was during this time last year that I became the editor of the *Engineer's Digest* in the Office of Engineering.

At the time, I realized that I could not do this job alone. I needed your help then, and I need your help now!

To keep the *Digest* the best publication of its kind, please continue to send your articles, comments, ideas, and suggestions to me.

While you were away forgetting life around the old neighborhood this summer, I hope that you did not forget the *Digest*.

So, remember the *Digest* while making your plans for the fall, and keep the manuscripts coming!

Annelle

Engineering News

378' FRAM Update

The FRAM contractors, Bath Iron Works (BIW) and Todd Pacific Shipyards, have completed the majority of the rip-outs required for the renovation and modernization of the first 378's entering FRAM.

Contractor detailed design is under way having overcome initial problems to control the post-FRAM configuration. The problems were caused mainly by different approaches by each contractor related to the heating, ventilation, and air conditioning (HVAC) systems and difficulties with the initial torpedo room configuration and handling system. Issues related to standardization between the two contractors' approaches were resolved by an ad hoc Action Team comprised of the COs of each RIO, various headquarters' staff elements, and Navy representation.

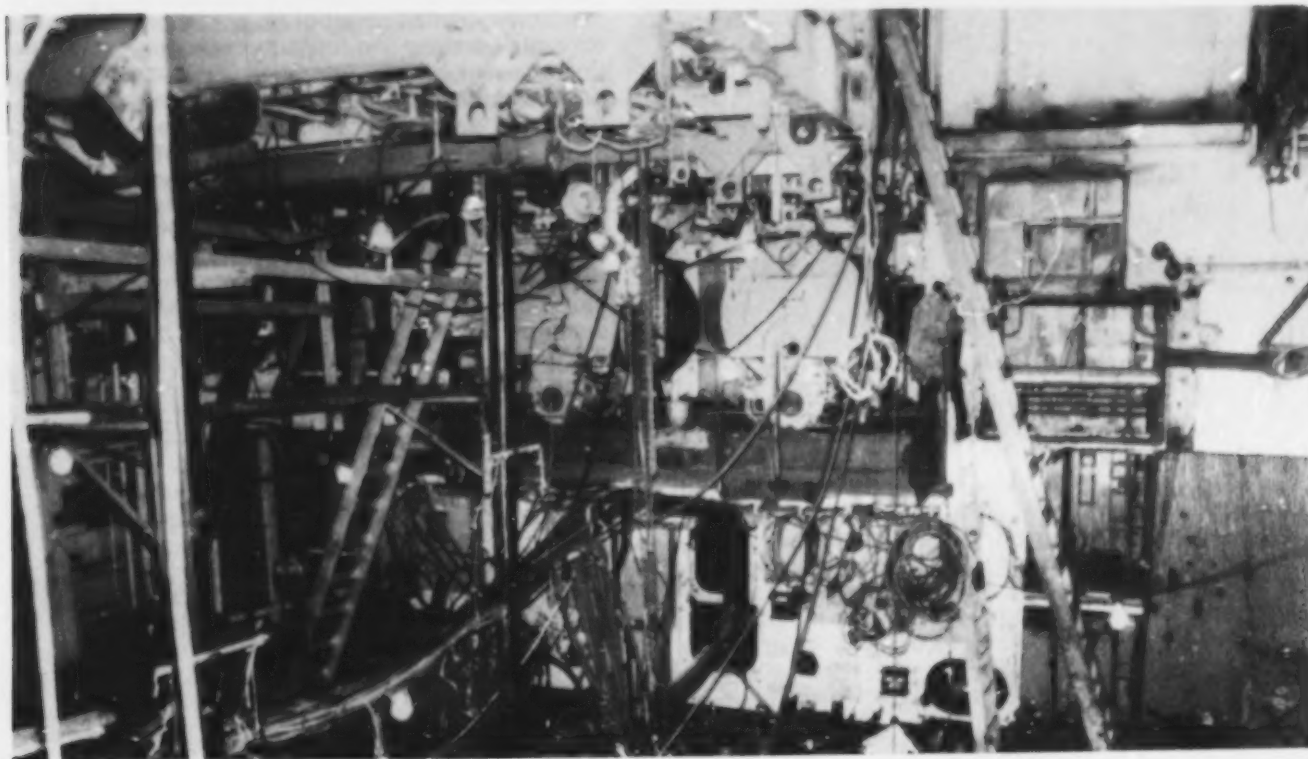
The USCGC *Hamilton* from BIW will be late due to cracks found during the Philadelphia Gear (PG) inspection of the reduction gears accomplished at the PG plant. Prior to the discovery of the cracks, the reduction gears were sent to PG for repair of the known problems with the port bull gear and bearings and for the installation of SSS clutches.

Replacement Polar Icebreaker

This project is roughly 2 years through the projected 3-year design cycle. The preliminary design, which describes the finalized version of the design, was scheduled to be completed on September 26, 1986. The contract design, which converts the engineering detail of the preliminary design to specifications and drawings suitable for contract award and execution, is scheduled to be completed on November 23, 1987. The award of the shipbuilding contract should be made prior to the end of fiscal year 1988.

The model test program was completed in July, including optional test items to examine modifications to the hull lines, appendages, and operation of the thruster. A great deal of effort has been devoted to optimizing the arrangements. As a result, one deck level was removed from the superstructure.

The Design Branch is also making extensive use of a technical support services contract that was awarded for the first time this year. This contract may assist in the analysis of the structure and structural vibration, stack gas plume analysis, and analytic verification of icebreaking capability.



The engine room without machinery.



Close view of barrier, inflatable floats on side away from oil.

Skimming Barrier Maintenance Contract

The Coast Guard skimming barrier maintenance contract for fiscal year 1985 was completed. The maintenance was performed by Offshore Devices, Inc., of Peabody, MA, which also designed and built the Coast Guard's skimming barriers. The 1985 contract supported corrective maintenance for two barriers belonging to the Gulf Strike Team which were damaged during the Alvenus oil spill and one from the Atlantic Strike Team which was damaged during offshore testing. A similar requirements contract for repairs is planned for fiscal years 1986-88 as needed.

Hazardous Waste and Used Oil Storage Tanks

The final regulations on above and underground tank systems storing hazardous waste were issued on July 14, 1986, as "Hazardous Waste Management System: Standards for Hazardous Waste Storage and Treatment Tank Systems and Generators (51 FR 25421)." The application of the final regulations will take effect on January 12, 1987. Standards for hazardous waste generators (generating more than 1,000 kg/mo) that accumulate hazardous waste in tanks are promulgated under 40 CFR Part 262 and 265. The regulations require full secondary containment with monitoring for new tank systems and for existing tank systems. The time frame for bringing existing tank systems into compliance depends upon the substance being stored and the age of the tank. The period of time and the requirements for secondary containment can be found under 40 CFR Part 265.193. The proposed regulations also specify certain operating procedures (Part 265.194), daily inspections (Part 265.195), and response to leaks or spills (Part 265.196).

Special requirements were promulgated under 40 CFR Part 265.201 for generators between 100 and 1,000 kg/mo that accumulate hazardous waste in tanks, provided that storage does not exceed 180 days (270 days if greater than 180 miles from disposal site) or 6,000 kg. These generators are not required to provide secondary containment or monitoring at this time but must comply with special operating and inspection requirements. The Environmental Protection Agency (EPA) will propose standards for these generators in the future.

There has been considerable confusion between the above *Hazardous waste tank regulations*, which are promulgated under *Subtitle C* of the Resource Conservation and Recovery Act (RCRA) as part of the standards applicable to generators of hazardous waste, and the *regulation of underground storage tanks under Subtitle I* of RCRA, which applies only to underground tanks storing petroleum products and regulated substances as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The hazardous waste tank regulations refer to both above and underground tanks and to used oil if it is determined to be a hazardous waste.

Many units store used oil and other contaminants in tanks. Many tanks are an integral part of the facility and their use is necessary. However, some tanks are used as a convenient storage location for long-term storage of used oil and other contaminants. Under EPA proposed regulations (50 FR 49212), used oil may be regulated as a hazardous waste. The Coast Guard is taking the

position that tanks used to store used oil will comply with the above hazardous waste tank regulations. Therefore, existing tanks which store used oil should be tested to determine if they are leaking. Many of these tanks will require modifications to comply with the above requirements. Tanks will not be acceptable for storing hazardous waste and used oil if they can not comply with the secondary containment or monitoring requirements. Finally, hazardous waste and used oil will not be stored in old, abandoned underground tanks. One alternative is to store liquid waste in drums in a properly designed storage area in accordance with the hazardous waste management requirements (Parts 260-262); i.e., storage does not exceed 90 days.

All new tank systems storing hazardous waste and used oil will comply with requirements for monitoring and secondary containment. Placement of the tank above ground is preferable. A Spill Prevention Control and Countermeasure (SPCC) Plan is required for aboveground tanks (40 CFR Part 112). If an aboveground tank is not practical, an underground tank with double walls and monitoring device is acceptable outside the building. If any tank must be placed below a concrete floor, a vault is recommended since it serves as secondary containment. Inspection would then be relatively easy, as well as replacement of any leaking tank. If a vault presents a safety problem, then the tank should be placed outside the building. Design considerations and drawings for hazardous waste storage tanks were presented in the proposed regulations under 50 FR 26444. Commandant (G-ECV) is preparing a COMDTINST to address both hazardous waste storage tanks and underground storage tanks. Questions can be referred to Mr. Michael Green, G-ECV-2 (FTS 267-1921).

Midcontinent Loran

The Coast Guard is currently evaluating a proposal by the Federal Aviation Administration to complete Loran C coverage throughout the continental United States as a part of the National Airspace System. The proposal would close the midcontinent gap in existing Loran C coverage, enabling suitably equipped aircraft to fly nonprecision approaches to airports which do not have standard instrument approach procedures. It would also enable direct IFR routing to coastal areas. The proposal involves the construction of 4-6 new Coast Guard operated transmitting stations, several monitor sites, and the installation of double rate equipment at several existing Loran C stations.

Diver Recompression Chamber Procurement Update

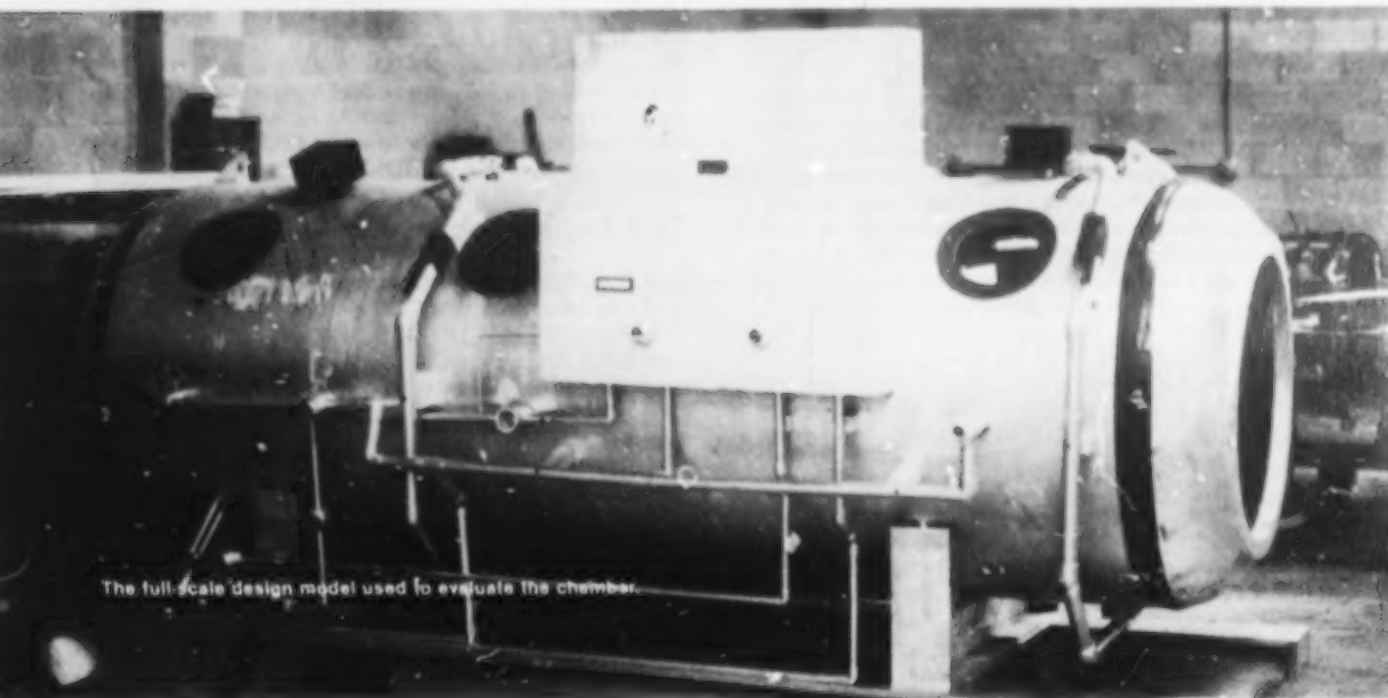
In August 1986, the pressure vessel for the first Coast Guard diver recompression chamber was scheduled for ASME Section VIII, Division 2, hydrostatic and pneumatic testing at Chicago Bridge and Iron, Inc.

After successful testing and ASME certification, the pressure vessel will be shipped to CACI, Inc., the prime contractor, in Beltsville, MD.

At CACI, the pressure vessel will be outfitted, plumbed, cleaned, and operationally tested.

Delivery is scheduled for November/December 1986 at the Coast Guard Ship Support Facility in Seattle, WA.

The chamber will be stored and shipped in a standard (8'x8'x20') shipping container.



The full-scale design model used to evaluate the chamber.



The 56' cable layer will carry a five-member crew. It will service the aids to navigation missions along the New England coast.

Coast Guard Yard Converts Landing Craft to Cable Layer

Personnel at the Coast Guard Yard in Curtis Bay, MD, recently completed a conversion of a surplus Navy landing craft to a Coast Guard cable layer. The project was not unfamiliar to the Yard. In 1960, Yard workers engineered the first conversion of a landing craft to a Coast Guard cable laying boat. It has operated successfully for the past 26 years along the New England coast. But because of its age and extensive use, the Coast Guard sought a replacement.

The conversion design of the 1980's called for a stronger, heavier cable laying boat. Nearly half of the landing craft's metal was replaced and a new bow section fabricated and joined to the stern. The new vessel has two propulsion diesel engines and a third diesel engine to drive an electrical generator and hydraulic pumps. The project added a deck house, auxiliary machinery space, and improved the habitability areas.

The black hulled cable laying vessel will become part of the Coast Guard's First District Aids to Navigation Team's work boats. Home ported in South Portland, ME, the vessel will be tasked with laying phone and power cables between the northeastern coast's shores and offshore structures, such as lighthouses.

Civil Engineering Manual Revision

The Civil Engineering Division has published Phase 1 of the newly revised Civil Engineering Manual (COMDTINST M11000.11). The revised manual is a complete rewrite and contains broad civil engineering policy direction to be used by civil engineers at District offices and Headquarters' units in the planning, design, construction, and maintenance of the Coast Guard shore plant.

The revision will be published in three phases. Until all three phases have been distributed, the old Civil Engineering Manual remains the source document for civil engineers.

Civil Engineering Training

The seventh annual Civil Engineering Management Training Course was held May 13-15 at Coast Guard Headquarters. The course, as in previous years, was for those individuals recently assigned/transferred as new assistant branch chiefs, facilities engineering officers, or technical assistants. Various topics were included so as to provide a broad overview and synopsis of civil engineering functions and responsibilities. A partial listing of these topics included: civil engineering management system, shore facility planning, design policy and standards, project documentation/structures, vehicles/energy, and the civil engineering data system (CEDS). Two new topics this year were hazardous waste management and discussion of the regionalization proposal. The course provided an opportunity to expose the attendees to civil engineering management in an atmosphere where the daily work environment did not interfere with the effective training.

Coast Guard Yard Renovates World War II Buoy Tender

Personnel at the Coast Guard Yard in Curtis Bay, MD, recently completed a renovation of the Coast Guard cutter *Conifer*, a 180-foot, oceangoing buoy tender. The overhaul of the World War II vintage vessel marked the fourth renovation of a Class "A" buoy tender under the Coast Guard's Service Life Extension Program (SLEP). The Yard completed restoration of the Coast Guard cutter *Sorrel* and

the USCGC *Gentian* in 1983. In 1984, the USCGC *Cowslip* underwent renovation. The Yard anticipates renovating a total of 14 buoy tenders under the SLEP by the early 1990's.

The USCGC *Conifer* received all new equipment—main diesel engines, evaporator, a Marine Sanitation Device system, a propulsion control computer, electronics and navigation equipment, and a central fluid power system. The project also involved a rewind of all DC propulsion equipment and rehabilitation of the ship's berthing spaces and sanitary facilities. Major construction work included a reconfiguration of the ship's superstructure from "A" to "C" class as well as improved water tight capability.

The USCGC *Conifer* was commissioned in 1943 and immediately assigned to wartime duty in Boston, MA. During the remainder of World War II, *Conifer* participated in Greenland patrols, providing logistics to remote sites and coastal weather stations. The ship also provided communication relays and served as a weather patrol vessel in the North Atlantic. At the conclusion of the war, *Conifer* was reassigned to Portsmouth, VA. Since that time, her home port alternated between Portsmouth and Morehead City, NC. She came to the Yard 3 years ago to undergo SLEP.

The USCGC *Conifer* will be assigned to the Eleventh Coast Guard District, San Pedro, CA. Her primary mission will be aids to navigation, servicing the area extending from Point Conception to the Mexican border. She will also be tasked with search and rescue and enforcement of laws and treaties along the California coast.



The USCGC *Conifer* upon completed renovation at the Coast Guard Yard in Curtis Bay, MD, awaits departure for its home port.



Aircraft maintenance officer students for 1986 (from left to right): LT Gail Donnelly, LT Jim Moukowsheer, LT George Heintz, LT Doug Bogle, LT Joe Touzin, and LT Mike Vandoren.

Aircraft Maintenance Officer Training

On June 10, 1986, six officers began their 1-year Aircraft Maintenance Officer Training Program with indoctrination visits to the Aeronautical Engineering Division, USCG Headquarters, and the Coast Guard Aircraft Repair and Supply Center, Elizabeth City, NC. Upon completion of their training, these officers will be designated aircraft maintenance officers and assigned to the engineering department of an air unit.

This program consists of on-the-job and resident training at Coast Guard, Air Force, Navy, and civilian schools and is designed to provide the information necessary to efficiently manage a unit's engineering department. Mandatory courses include nondestructive inspection theory, corrosion control, composite repair, jet engine accident investigation, aviation administration, and officer leadership and management. On-the-job training involves completing a syllabus while performing a variety of collateral duties under the supervision of the unit's engineering officer.

LT Gail Donnelly is the first woman to begin the Aircraft Maintenance Officer Training Program.

Upon completion of this program, she is scheduled for assignment as polar operations aircraft engineering officer at Aviation Training Center Mobile.

The Aeronautical Engineering Division typically sponsors between 10 to 15 officers per year for this program. Officers interested in this training should refer to COMDTINST 1500.10A.

Technology Degrees

The New York State Regents College Degree Program is now offering associate and bachelor degrees in computer, electronics, and nuclear technology. It offers no courses but combines credits from accredited colleges, correspondence courses, tests, Coast Guard and other military schools and enlisted rates, and personal assessment. Further information can be obtained by calling (518) 474-3703 or writing to:

The University of the State of New York
Regents College Degrees
Cultural Education Center
Albany, NY 12230

New Gas Meters Procured by Ocean Engineering Branch

Coast Guard marine safety personnel (MSO, MIO, and COTP units) received new, pocket-size, Scott S105 combustible gas/oxygen meters this summer. These meters, which are required for entry into a confined space, represent a dramatic improvement over the 6-year-old Biomarine meters they are replacing. They are less than half the size, weight, and cost of the old meters and are completely broken up into components for easy field repair. These meters warn the users whenever they enter an oxygen deficient or explosive atmosphere by sounding an audible alarm and displaying a digital read out of the gas concentration.

Also in the works is a Scott S105 support contract. This contract, which will cover all meter components, will also be funded by Headquarters. Field units requiring meter parts or supplies will be able to place the orders over the phone without paperwork delays. This contract will be in place about January 1987 at which time instructions will be given for the ordering procedure. Questions about these meters should be forwarded to the Ocean Engineering Branch (G-ECV-5) at FTS 267-1858.

Environmental Compliance Program Absorbed by Civil Engineering Division

The Offices of Merchant Marine Safety and Marine Environment and Systems were consolidated into a single Office of Marine Safety, Security, and Environmental Protection on August 1, 1986. This reorganization resulted in the Environmental Compliance and Review Branch (G-WP-3) being merged with the Civil Engineering Division (G-ECV).

Responsibilities associated with the environmental compliance program which will be undertaken by the Civil Engineering Division include the following:

- Plan, develop, promulgate, and update procedures and implement, monitor, advise, and review the Coast Guard program for:
 - (a) compliance with the National Environmental Policy Act (NEPA),
 - (b) abatement of pollution from Coast Guard facilities, and
 - (c) control of hazardous waste and toxic substances at all Coast Guard facilities.
- Coordinate the review of Coast Guard and non-Coast Guard environmental impact statements, finding of no significant impact (FONSI) statements, and environmental assessments and categorical exclusions.
- Assist in the preparation of environmental documentation for Coast Guard Headquarters' actions.



New, pocket-size, S105 combustible gas/oxygen meter.

- Review proposed Federal regulations necessary to implement all Coast Guard programs, regarding compliance with environmental laws such as the NEPA; the Floodplain Management Guidelines, Wetlands Executive Order; the DOT 41 requirements for the protection of public parks and recreation lands, wildlife and waterfowl refuges, and historic sites; the Fish and Wildlife Coordination Act; the Endangered Species Act; and the National Historic Preservation Act.
- Monitor Coast Guard compliance with the Resource Conservation and Recovery Act (RCRA) and the Toxic Substances Control Act (TOSCA), including development of Coast Guard programs for management of hazardous waste and PCBs.
- Coordinate pollution abatement responsibilities under the Clean Air Act and the Clean Water Act, specifically the National Pollution Discharge Elimination System (NPDES) Program.

In addition, the Civil Engineering Division has assumed responsibility for directing a Coast Guard-wide groundwater and underground storage tank cleanup program in an effort to reduce the likelihood of future, unexpected environmental cleanup projects. The specific responsibilities are summarized as follows:

- Headquarters' planning coordinator for hazardous waste and groundwater cleanup projects (e.g., Traverse City and Elizabeth City).
- Manage underground tank program relating to tank testing and monitoring, removal, replacement or repair and cleanup of contaminated soils and groundwater.
- Provide expertise and review projects involving hazardous waste and regulated substances (e.g., storage facilities, pretreatment facilities, oily water separators, and containment facilities).
- Coordinate studies and surveys to determine if

cleanup efforts are needed, to assess if facilities are maintained and operated properly, and to provide recommendations for preventing future spills.

- Establish policies and procedures for hazardous waste and groundwater cleanup efforts, tank replacement, and treatment facilities.

Engineering staff at the districts' and Headquarters' units will be affected by the additional responsibilities associated with the groundwater and underground storage tank cleanup program. Commandant (G-ECV) is providing guidance and instructions regarding these new responsibilities. Questions can be referred to Mr. Michael Green, G-ECV-2 (FTS 267-1921).

Fellowship for Engineers in Management Available

The National Society of Professional Engineers (NSPE) Education Foundation announces its Fellowship program for practicing engineers. The Fellowship is a \$1,000 stipend for a practicing engineer who is pursuing a masters degree in some form of management.

This Fellowship was endowed by the 9,000 Professional Engineers in Government (PEG) division of NSPE and is open to all engineers (Professional Engineers or Engineers-In-Training) in any field of practice as well as Federal, state, and local Government engineers.

Fellowship applications are available from Gay Maley, Director, Education Foundation at (703) 684-2830. Additional questions on the Fellowship should also be directed to Ms. Maley.

The deadline for submission is no later than February 16, 1987.

Share Your Knowledge Submit Your Ideas, Suggestions, Articles, etc., to:

Coast Guard Engineer's Digest
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Washington, D.C. 20593
Attn.: Editor, G-Eg

**Don't Wait!
Do It Today!**



Avionics Briefs

- **Secure communications.**—Secure voice equipment will be installed in all Coast Guard aircraft, excluding the HH-52A. KY-75 (PARKHILL) will be on HF and KY-58 (VINSON) on UHF. AR&SC is prototyping and developing kits for field installation.
- **HF replacement C-130 and H-3.**—The AN/ARC-190, manufactured by Rockwell-Collins, has been selected to replace the 618T-2 on HC-130H and HH-3F aircraft. The ARC-190 will be the Air Force standard 400W transceiver.
- **VHF/AM replacement H-3.**—The Wulfsberg WT-200B VHF/AM radio has been prototyped in the HH-3F. This radio will satisfy the near-term requirement of 25 khz channel spacing as required by the Federal Aviation Administration (FAA) for full services. Procurement of units for fleet installation is in process.
- **New HH-3F doppler.**—A new doppler radar system has been selected for the HH-3F. It is the AN/APN-217, manufactured by Teledyne-Ryan, Inc. This equipment was selected after a flyoff at NATC Patuxent River determined its superior performance over smooth water. The APN-217 is in extensive use in the Navy and has demonstrated MTBF of over 2,000 hours. Thanks to Air Station Cape Cod for providing an HH-3F and crew for the NATC evaluation last fall.
- **C-130 search radar.**—The AN/APS-137 radar, manufactured by Texas Instruments, is being procured by the Navy for our C-130 aircraft. This radar will also be used on Navy P-3 and S-3 aircraft. It can detect a small boat at 20 nm in sea state 5, track 32 targets at a time, and provide an image of a vessel suitable for classifying vessel type and length. The newest C-130, 1716, will be delivered with provisions for the APS-137, and the first installation is expected early in 1988.
- **AIREYE.**—The prototype AIREYE system is now operating at Air Station Miami. It utilizes SLAR, IR/UV line scanner, Active Gated Television (AGTV), and a reconnaissance camera to provide wide-area, day/night surveillance. Five additional systems are on order and will be delivered to Miami, Sacramento, and Cape Cod in 1987. Unfortunately, continuing problems with the AGTV procurement mean that it will not be available when AIREYE is delivered.
- **Electromagnetic compatibility (EMC).**—G-EAE has initiated an EMC program to insure avionics systems have minimal degradation due to electromagnetic interference (EMI). The program is still in its infancy, but several aircraft have been surveyed. EMC engineering is considered in all retrofit installations of avionics systems. We also have the capability to troubleshoot and resolve EMI problems in the field.

1986 Federal Energy Efficiency Award Presented to Ocean Engineering Division

The Ocean Engineering Division (G-EOE) has received the 1986 Federal Energy Efficiency Award for work in the area of energy conservation; specifically, for exceptional achievement in the application of solar power to aids to navigation (AtoN). The awards are presented annually by the Federal Interagency Energy Policy Committee ("656" Committee) to recognize outstanding contributions toward increased energy efficiency within the Federal sector.

This year, the Federal Energy Efficiency Awards were presented to 15 individuals and 17 organizations at a luncheon ceremony during Energy Awareness Month. The ceremonies were held on October 2, 1986, at the Russell Senate Office Building in Washington, DC.

Engineer of the Year Update

The Office of Engineering will soon announce the Coast Guard Engineer of the Year.

In support of this program, the Office of Engineering sent letters to district commanders, commanding officers of Headquarters units, and Headquarters office chiefs to request their support in nominating their top engineer candidates. The deadline for nominations was December 10, 1986.

The Coast Guard Engineer of the Year will be selected by a panel of judges. Judging will take place during the week of December 15, 1986, and will be based on the following criteria: professional registration (10 points), education (15 points), continuing competence (20 points), professional and/or technical society activities (10 points), awards or honors (10 points), civic and humanitarian activities (15 points), and engineering achievements (20 points).

The Coast Guard Engineer of the Year will then be placed in competition for the Federal Engineer of the Year, who will be selected during National Engineers Week (February 22-28, 1987).

Graduate Scholarships in Naval Architecture, Marine Engineering, and Ocean Engineering Available

The Society of Naval Architects and Marine

Engineers (SNAME) is again making funds available to assist young men and women in the U.S. and Canada towards pursuing a career in the marine field by annually awarding Graduate Scholarships for advanced study in the fields of naval architecture, marine engineering, and ocean engineering, although not necessarily limited to these subjects. The value of each Graduate Scholarship usually covers the cost of tuition at the school selected. The exact amount of the award will be established by the Scholarships Committee. The scholarships will be available for the academic year commencing in the fall of 1987.

The Scholarships Committee of the Society has stated that these scholarships should be awarded to applicants who are qualified to pursue advanced study and who also have ambition, personality, and characteristics indicative of future leadership in the marine industry. The candidates will be judged on these qualities as well as on their academic record. For at least one scholarship, emphasis will be placed on recent employment of at least 5 years in the marine field as a factor for selection.

In connection with the above, application forms may be obtained from Society headquarters at the following address:

One World Trade Center
Suite 1369
New York, NY 10048

The completed applications should be directed to Mr. Robert G. Mende, Secretary and Executive Director, no later than February 1, 1987.

Graduate Scholarships In
Naval Architecture
Marine Engineering
And Ocean Engineering . . .

ARE NOW AVAILABLE
FOR RECENT GRADUATES
OR CURRENT UNDERGRADUATES
DEADLINE: FEBRUARY 1, 1987

HH-65A Snow and Ice Operational Capability: The 1986 Ottawa Snow and Ice Testing

By CAPT Sperry C. Storm
Aircraft Program Office
Grand Prairie, Texas

Introduction

The HH-65A *Dolphin* helicopter, manufactured by the Aerospatiale Helicopter Corp. in Grand Prairie, TX, is now operational at several "warm weather" sites. The 1986-87 winter season will see its first use at "cold weather" sites.

The road to final acceptance of the helicopter has been difficult. There have been some problems, each being resolved/worked out by the efforts of the Coast Guard and the contractor. Two of the most difficult problems have been the operational capability of the helicopter to fly in falling and/or blowing snow, and the confidence that an adequate safety margin exists in the event of an inadvertent ice encounter. Although separate, these problems have been approached as one, as they have been resolved by one major modification to the baseline HH-65A helicopter.

Putting aside the issues of contractual requirements, this article focuses on what has been done to modify the baseline helicopter and the resultant improvement in operational capability.

Operational Considerations

First, however, one must understand that it was never intended to allow nonrestricted operation in icing conditions. As of this writing, there is only one helicopter in the free world that has been certified to do so. Coast Guard missions for the Short Range Recovery (SRR) aircraft include a requirement that an adequate safety margin exist that allows flying out of an inadvertent ice encounter. In other words, the engines have to be able to continue running long enough for the pilot to recognize that he is in ice and to take corrective action to get out of that situation. However, it was always envisioned that the selected SRR aircraft would be capable of operations nonrestricted in snow.

Early Tests

After the baseline helicopter was tested, a Coast Guard Aircraft Program Office (APO) flight crew experienced engine surges in recirculating snow in

Dallas, TX, in December 1983. This served to confirm earlier apprehension, generated during earlier tests, concerning the operational characteristics of the helicopter in snow, and the contractor proceeded to find a solution.

Solutions

After the contractor identified a solution, an engine inlet modification that changed the air inlet screens and engine compressor housing was placed into production, with the first delivery scheduled for November 1985. The Coast Guard, after changing the implementation schedule to the extent necessary to keep the helicopter in a warm, nonsnowy environment and with very restrictive snow operational limitations in the pilots flight manual, accepted the first unmodified HH-65A helicopter in November 1984. Just after this initial acceptance, in early 1985, there were concerns over the safety margin available to ensure continued engine operation if an inadvertent ice encounter occurred. These concerns were confirmed during the ongoing ice tests of the unmodified helicopter in Ottawa, Canada. This posed acceptance questions and resulted in additional operational limitations concerning operation in freezing temperatures. However, a high degree of confidence existed that the proposed snow modification would also resolve the issue of an adequate ice operation safety margin. This confidence was bolstered by tests completed with a prototype modified HH-65A in snow during late 1984 and in ice at the Ottawa test facility during February-March 1985. Because of the limited data available from these tests and a desire to accomplish specific Coast Guard objectives, the APO was authorized to conduct a Coast Guard test plan during 1986 at the National Research Council Ice Testing Facility in Ottawa for the modified HH-65A.

Modifications

Before describing the 1986 tests, a description of the modification to the helicopter and engines is necessary. The baseline HH-65A is equipped with AVCO Lycoming LTS-101-750-A1 (referred to as the A1) engines. Eighteen aircraft were accepted and successfully operated at the warm weather

stations, within the imposed operational limitations in this configuration. The designed ice protection for the A1 consisted of the combination of a Foreign Object Damage (FOD)/Ice Screen over the engine inlet duct entrance (see figure 1A) and an engine bleed air anti-ice system which provided a supply of heated air to the engine inlet housing struts. (See figure 2.) The anti-ice bleed air system was controlled by pilot operated switches (one for each engine) in the cockpit. The FOD/Ice Screen was designed to ice over in icing conditions, resulting in the deflection of the moisture laden air to the side and around to the bypass at the trailing edge of the screen. It was believed that the moisture would be drawn out of the air by the aerodynamic action of the air "making the turn" to enter the bypass, thereby eliminating the icing problem for the engine. But, it was proven that this theory did not hold true for all flight regimes. In forward flight, an ice cap builds up on the front of the FOD screen. (See page 15.) The icing environment or liquid droplets then attach to the ice cap or are deflected to the side of the screen and past the bypass. In the event of total screen blockage, the bypass still provides an adequate air supply for normal engine operation. During ground and hover tests at Ottawa, without the effect of forward velocity, the ice cap did not form, yet, in some environments, near total screen blockage was experienced. Thus, the bypass area would be providing most of the air supply. Without adequate forward velocity, the ice particles would collect and start blocking the bypass area.

During hover tests conducted, the ice forming in the bypass area was subsequently ingested into the engine causing engine surges and damage. Snow problems were encountered due to the snow

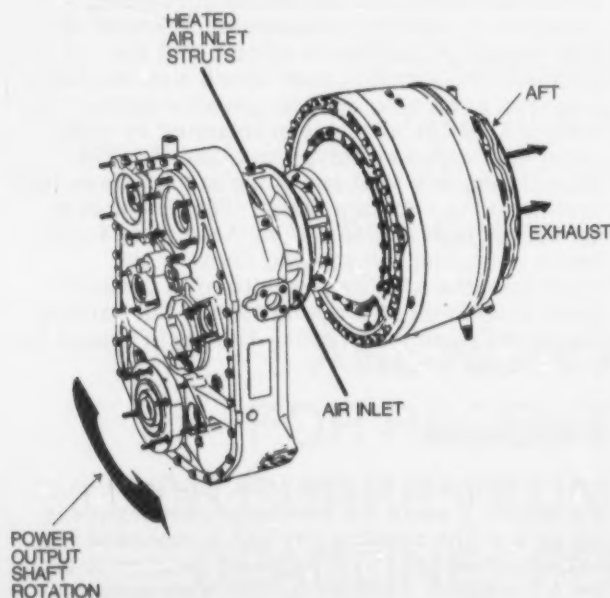


Figure 2. Heated inlet struts.

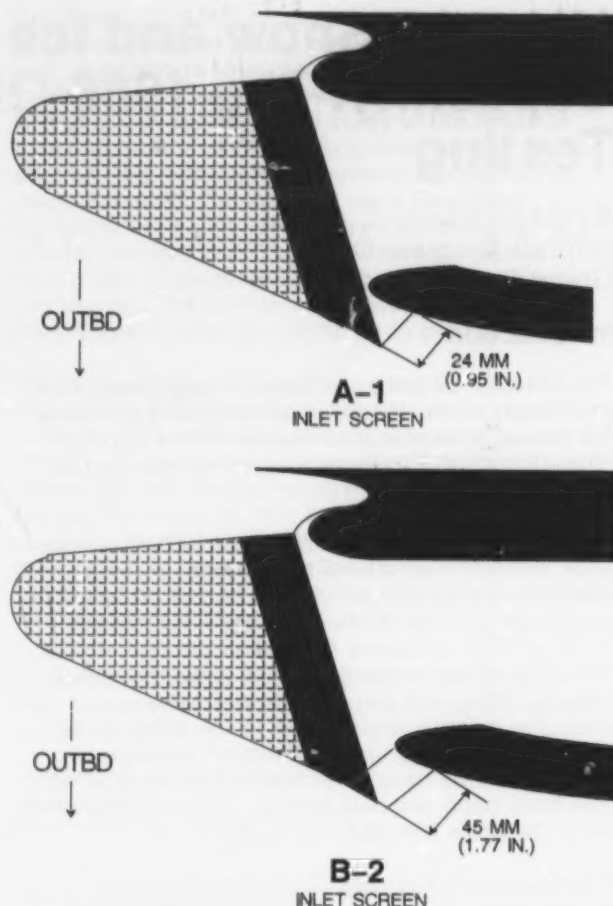
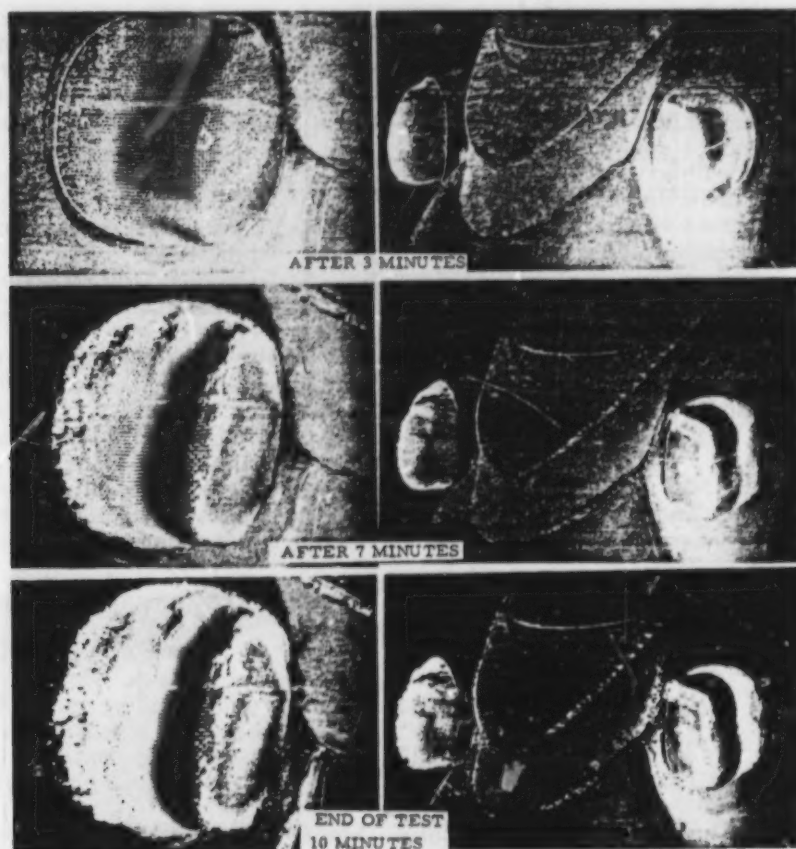


Figure 1. Inlet screens.

laden air entering the inlet duct and collecting in quantities of sufficient volume in the uneven contours of the duct that it formed ice-like chunks. When they broke loose and were subsequently drawn into the compressor, this snow and the ice-like chunks would cause engine surges and possible engine damage. The bleed air anti-ice system was not designed to de-ice; therefore, it is not capable of thawing ice chunks of any size before entering the engine.

The modified configuration is identified as the LTS-101-750-B2 (referred to as the B2) engine. In this configuration, the same external combination FOD/Ice Screen is used over the engine inlet duct entrance, but the bypass area is enlarged. (See figure 1B.) The engine air inlet scroll is replaced by a plenum with an electrically heated aft conical panel. (See figure 3.) The hollow inlet struts continue to be heated by engine bleed air. The electrically heated panel and the engine bleed air for heating the struts are controlled by the same pilot operated switches in the cockpit as the earlier configuration. The most important change, in terms of correcting the snow and ice problem, was the addition of a radial screen over the



AS 366G/LTS 101-750A-1 inlet icing test.

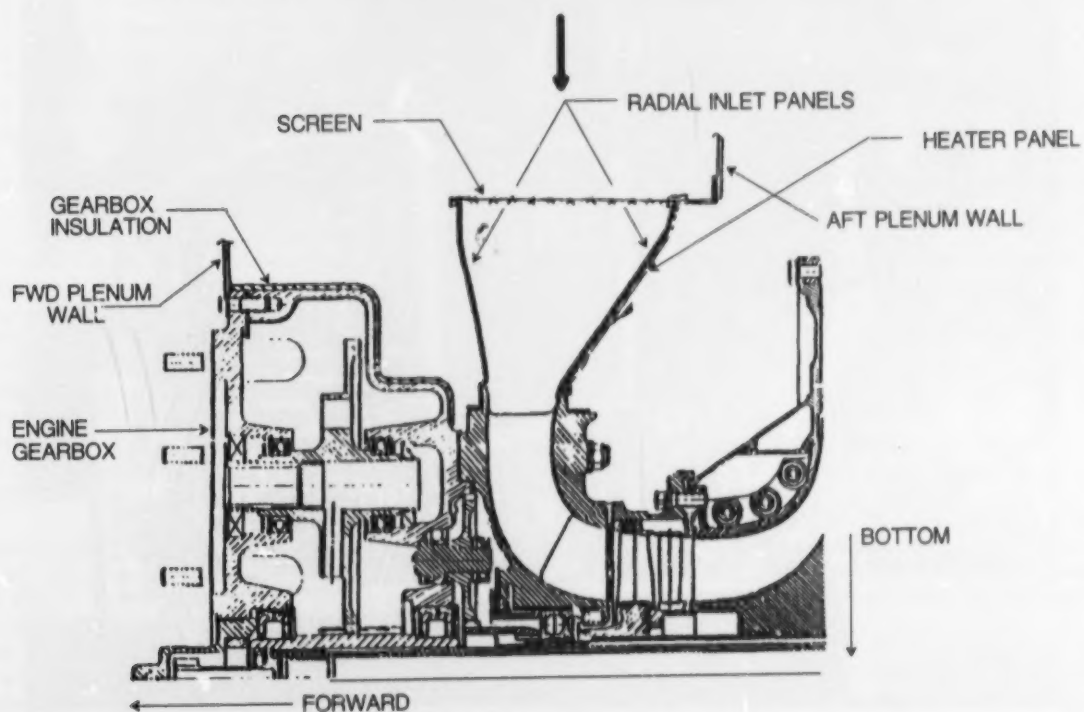


Figure 3. LTS101-750B-2 radial inlet panel installation.

compressor inlet inside the plenum. (See this page.) The addition of the screen and plenum required the redesign of the engine compressor front frame. The certified design also required the addition of an engine gear box insulating blanket to provide some protection against the possibility of airflow discontinuity. This discontinuity is caused by heated air generated by the engine gear box now enclosed by the plenum. The first B2 equipped HH-65A was delivered on schedule in November 1985.

The 1986 Tests

To complete testing of this new modified helicopter for Coast Guard acceptance and operational purposes, five objectives were put in place:

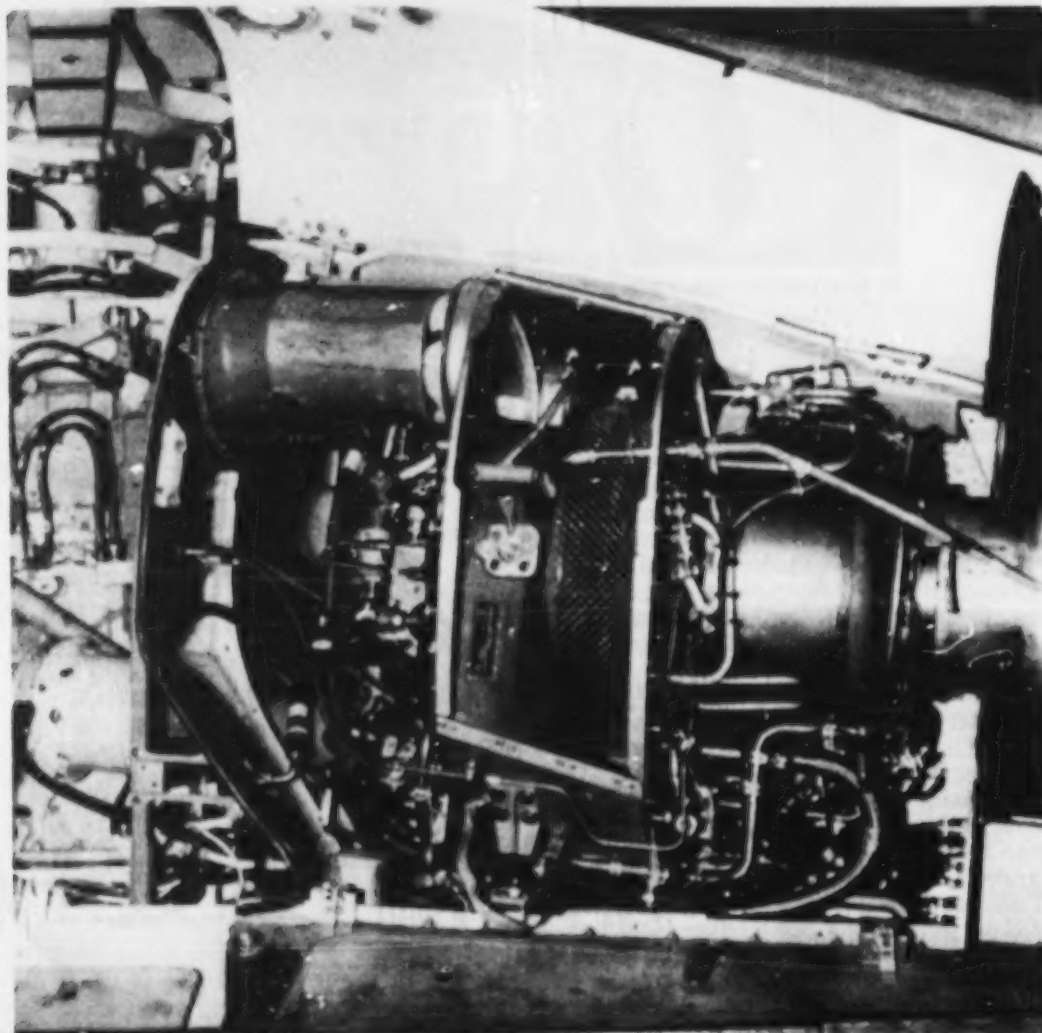
1. To confirm compliance with the contract requirements concerning Federal Aviation

Regulations (FARs) for certification and the Military Specification (MILSPEC) SD-24-K for helicopter ice operations.

2. To evaluate the capabilities of the HH-65A with the B2 modified engines versus Coast Guard mission requirements.
3. To compare the A1 to the B2 combination FOD/Ice Screen performance.
4. To determine the main rotor blade icing limitations.
5. To evaluate the B2 engine gear box blanket insulation.

In line with these objectives, a test matrix was developed and approved. (See figure 4.)

The Ottawa test facility is operated by the National Research Council of Canada. It is designed to simulate icing environments for helicopters in ground and hover flight operations. However, the facility is dependent on environmental conditions



LTS101-750B-2 engine radial screen.

TEMP		LWC	MVD	POWER LEVEL - DURATION (MIN)					ACCEL	REMARKS	REF
°C	°F	gm/m ³	M	HOVER	T/O	75%	50%	F/I	FI → T/O		
-20.0	-4.0	1.0	15		10	10	10	10	YES	ONLY IF ANTI ICE BLADES	c
-10.0	14.0	.60	30	30							b
- 8.0	17.5	.65	30	30							b
- 6.0	21.2	.69	30	30							b
		MAX AVAIL									
- 5.0	23.0	(.75)	25		10	10	10	10	YES		c
- 4.0	24.7	.72	30	30							b
- 2.0	28.3	.76	30	30							b
			>20								
-9/-1	15/30	.3→.6	(30)					30	YES		a,c
0.0	32	.8	30	30							b

REFERENCES - (a) FAR 29.1093

(b) SD 24 K

(c) AC - 20/73

Figure 4. Icing test matrix.

for simulation. The helicopter spray rig is operable only in winter months when suitable temperatures and wind velocities are available. At Ottawa, the most dependable icing season occurs between the beginning of January to mid-March.

The facility uses a vertically oriented array of spray nozzles that can be rotated about a single supporting mast to accommodate wind direction. The cloud is developed by a water treatment system, a steam generating plant, and a water booster pump which pumps the water and steam to the spray nozzles on the array. The plant and control facility is housed a considerable distance from the mast. A utilities tunnel contains the piping, control wiring, etc., which runs from the control facility and plant to the base of the mast.

Operations have been conducted at the facility for over 14 years and have involved many different military and civilian helicopters. As many as three helicopters may be on-site for a given period, requiring time-sharing of the spray rig. During the 1986 test period, the HH-65A shared the rig with a Canadian Forces H-46 Labrador helicopter. Although the H-46 testing had different objectives than the H-65, it was apparent that the H-65 stayed in the cloud for far more time than the H-46 was able to!

Depending on conditions, the rig can simulate either an icing or a freezing rain environment. Liquid Water Content (LWC) can be varied over the range of 0.1 to 0.9 grams per cubic meter and the average droplet size varies from 30 to 60 microns. Local wind conditions tend to be gusty with velocities up to 35 knots. Testing can be conducted during periods of snow if desired.

HH-65A CGNR 6521, a production delivered B2 configured helicopter, arrived at the test facility on February 5, 1986, and departed February 15, 1986. The APO flight crew consisted of CDR Bud Tardiff, LCDR Bruce Melnick, ADCS Rick Smallwood, AD1 Bob Evans, AD1 Ken McGuire, and AE2 Dave Engleman. Tests were conducted on 6 of the 9 days. The loss of test days was attributed to the weekend, and one day was lost due to calm winds since some wind is required to "blow" the cloud from the spray rig to the helicopter.

Twelve runs were made: six on the ground and six in a hover. Earlier testing experience indicated that the Liquid Water Content measurement was considered critical; therefore, no snow was to be present. As confidence was gained by the pilots in the capabilities of the system, precipitation was considered a noncritical element and, in fact, was desirable to more accurately simulate icing in snow conditions sometimes encountered during Coast Guard operations. The initial runs (runs 1-6) were made with an A1 screen mounted on one side and a B2 screen on the other. The runs conducted on the last test day had the heat blanket removed from the left engine to observe any performance or icing differences that might exist between the blanketed and nonblanketed configuration. The only instrumentation installed was one of Coast Guard APO design: a handheld altimeter in the cockpit, connected to a pressure pickup in each plenum, to monitor the differential pressure (delta P) caused by the inlet screens and bypass being blocked by ice.

The test points proposed by the test matrix (see figure 4), as compared to those actually flown, are depicted in figure 5. This figure is actually a

graphical version of the MILSPEC SD-24-K icing test requirements. Since extensive data was collected during the 1985 tests and a high level of confidence existed that the B2 system worked, a gradual buildup type of approach was not required. Therefore, all data points were flown at maximum concentration and duration. All engine parameters were manually recorded at least every 5 minutes during each run. All test results were documented both manually on data sheets and pictorially on film. The results were gratifying and go far in substantiating the capability of the HH-65A.

As with all simulated testing, the results, although impressive, did not answer all HH-65A icing questions. However, the helicopter with the B2 configuration had no difficulty in operating in the maximum icing environment that the Ottawa test facility could provide (LWC 0.9, droplet size 30 microns, temperature -6 degrees Centigrade, 40 minute duration, mixed with snow). This fact demonstrates a capability and provides a level of confidence that few, if any, helicopters can claim.

As far as the plan and the results attained, the tests were considered complete and successful. Although minimal data was obtained below -10 degrees Centigrade, it is felt that earlier tests proved that the rotor system was the limiting factor at those colder temperatures, not the engine system. Revisiting those temperatures would be testing in an unrealistic Coast Guard operational environment. Summarized below are the observed results with respect to the five objectives outlined previously on page 16:

1. Due to many reasons, the testing conducted could not substantiate FAA compliance. The reasons are varied but relate to insufficient aircraft

instrumentation, no FAA participation, no evidence of stabilization during some exposures, inability of the Ottawa facility to generate some FAA required environments, inconclusive interpretation of the applicable FARs, and, most notably, the Ottawa test is still a simulated environment. FAR Advisory Circular 20-73 entitled "Aircraft Ice Protection" states that one of the acceptable means to demonstrate compliance with FAR 33.68 is to operate the engine steadily under specific icing conditions for at least 10 minutes at separate power levels for a total of 40 minutes and subsequently accelerate to takeoff power. Further, "If ice is still building up at the end of 10 minutes, continue running until the ice begins to shed or until the engine will no longer operate." Although the engines survived a 40-minute immersion cycle and were accelerated successfully to takeoff power, it could not be substantiated that after a period of time the screens and bypasses would not continue icing over and subsequently cause the engine to "no longer operate satisfactorily." This may not meet the FAA interpretation of 33.68. However, it is also probable that this situation is only associated with prolonged hover operations in a severe environment. Simulations conducted at Saclay, France, of system operations in forward flight demonstrate a greatly reduced total screen blockage and no bypass blockage. Compliance with SD-24-K requirements remains subject to interpretations. Essentially these requirements are: "The inlet anti-icing system shall meet the conditions . . . (see the graphical

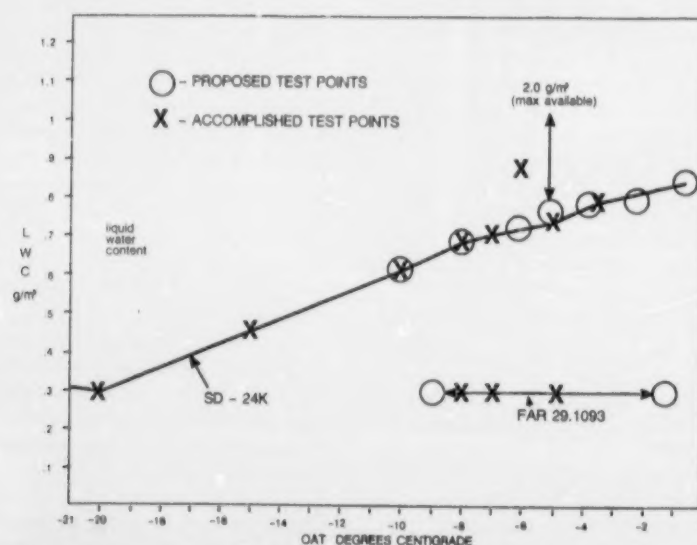


Figure 5. Test points accomplished.

presentation depicted in figure 5) . . . for ice-free operations for 30 minutes." If the inlet anti-icing system is considered to be everything down stream of the internal screen, the B2 configuration could be considered compliant. The definition of what part of the inlet is the engine system and what part is the aircraft system, for this purpose, has not been clearly defined.

2. The tests substantiate that the B2 system does, in fact, afford the pilot the capability to safely extricate himself from icing conditions encountered inadvertently. The tests the B2 were subjected to were all severe and of at least 30 minutes duration. The APO is satisfied that even the most extreme inadvertent icing conditions encountered by an HH-65A with B2 engines can be transited or exited safely, without the engines being the limiting factor.
3. Although design data was submitted that described how the different airflow patterns, afforded by the larger bypass gap, result in virtually ice-free operation, it appeared that the only reason the B2 bypass would take longer to become completely blocked is because of the larger gap to be bridged by the ice formations.
4. It was determined that -10 degrees Centigrade is the temperature above which the HH-65A rotor system has sufficient dynamic heating to remain virtually ice free. Small accumulations of ice accrete on the blades and are subsequently shed. The asymmetry of the shedding does create some mild, low-level vibrations that usually diminish completely within several seconds of the initial shedding. During this and previous Ottawa testing, operations below -11 degrees Centigrade resulted in ice accumulations on the rotor blades that would be hazardous to continued flight in a relatively short period of time, depending on the severity of the environment. This was only demonstrated in a hover with winds of less than 20 knots. Additionally, it should be emphasized that icing encounters below -10 degrees Centigrade are infrequent and, at normal helicopter operating altitudes, are indeed very rare.
5. Two data runs of 30 and 40 minutes were run with one of the heat blankets removed. The conditions were moderate, and severe icing coupled with light and heavy snow, respectively. There were no differences observed either in performance or ice accumulation inside the plenums of the two engines.

Conclusion

The HH-65A can perform all of its intended missions safely in ice and snow environments,

with the B2 modifications installed. The performance observed during severe icing and snow conditions was well beyond that imagined possible on an unprotected helicopter. Ice accumulations in excess of an inch were observed on door handles, antennae, and tail rotor carbon support tube. All the anti-ice systems including the windshield, the engine, and the pitot-heat kept their respective components ice free. Although the interior radial screen was at times iced over 40 percent of its circumference, ice was never observed on the inside of the screen, and engine performance was never affected. This condition was not unlike previous ice and snow tests with the B2 configuration, and the engine has been demonstrated to operate with this amount of blockage.

The single most important improvement of the B2 over the A1 is the inclusion of the interior radial screen. Regardless of location or quantity of ice accretions in the upstream ducting, the compressor is protected from FOD, including ice chunks, by the internal screen. It should be noted that the engine icing effects experienced during these tests in a hover are considered much more severe than had the same conditions been encountered in forward flight.

The HH-65A was never intended to be certified to fly in known icing conditions. It has demonstrated an unusual potential for a non-ice certified helicopter. The HH-65A is an ideal Instrument Flight Rule (IFR) aircraft and surpasses many fixed wing aircraft in its instrument flight capabilities. It will be spending more time in the IFR environment than any previous Coast Guard helicopter; therefore, the potential for inadvertent ice encounters increases. This helicopter can handle those encounters, but pilots cannot and should not treat this capability any differently than what it is intended to be: A safety margin such as reserve fuel, 50 feet extra at minimums, or "a little something extra for Mom and the kids back home."

About the Author

CAPT Storm enlisted in the Coast Guard in 1957, was commissioned in June 1964, completed flight training in December 1965, and was designated an aircraft maintenance officer in July 1969. He has served as the engineering officer at Air Stations Sangley Pt., Port Angeles, Borinquen, and Kodiak. CAPT Storm was assigned to the aeronautical engineering staff for two tours: First, as a systems manager; and later, as the Chief, Fixed Wing Branch. Prior to his present assignment as the Commanding Officer, APO Grand Prairie, TX, he graduated from the U.S. Air Force Air War College, Maxwell AFB, AL.

Chief Engineer's Comments

The ice and snow problems on the HH-65A required a significant amount of money, time, and effort by APO Grand Prairie to resolve. The HH-65A is one of the most environmentally tested helicopters ever produced in the free world. Pilots and crew can be assured that the aircraft will perform as advertised in adverse weather conditions.

Applying Thermography to the Insulation Industry

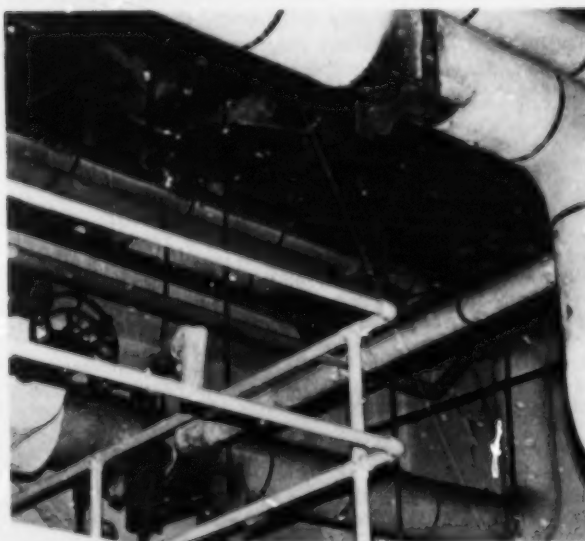
Reprinted, with permission, from *Insulation Outlook*, January 1986.

Introduction

Thermography can provide us with information on the temperature distribution and temperature changes within an insulation system. With the aid of microprocessors and digital photo-processing equipment, we can analyze thermal images in "real time operation." Using quantitative infrared thermography, specialists are said to be able to detect temperature differences of 0.2°C.

Wherever objects emit infrared waves of varying intensity, we can reproduce the respective differences graphically. For example, IR-thermography enables us to establish how and where the pipework of a floor heating system is laid.

The application possibilities for the maintenance and operation of machines and equipment are extremely diverse. Worn machine bearings and deficient soldered joints heat up quicker, to beyond the permissible limit. The search for overheated relays, motor, and transformer windings with a simple thermometer is like looking for a needle in a haystack. IR-thermography reveals such irregularities quickly and can thus prevent the appreciable costs associated with the failure of a complete production system if these dangerous hot-spots are located and remedied at an early stage.



The first real time systems became available about 1965. They now can produce up to 16 pictures per second and permit a direct view in the infrared range, even with low object temperatures.

System Applications

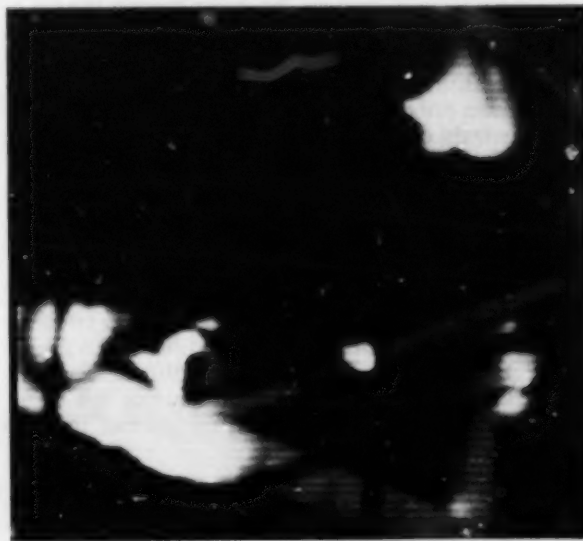
There are wide possibilities for the application of thermography in the building industry. For instance:

- Places with deficient or no thermal insulation;
- Sources of leaks such as escaping hot air;
- Leaks in steam traps and wind seals;
- Thermal bridges; and
- Dissimilar elements in building structures; e.g., the framework under plastered facades.

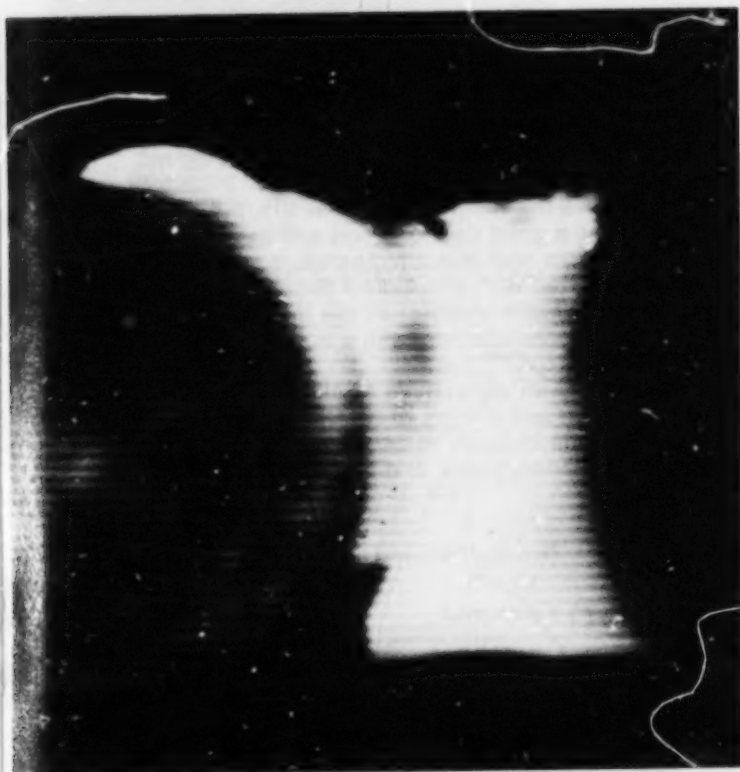
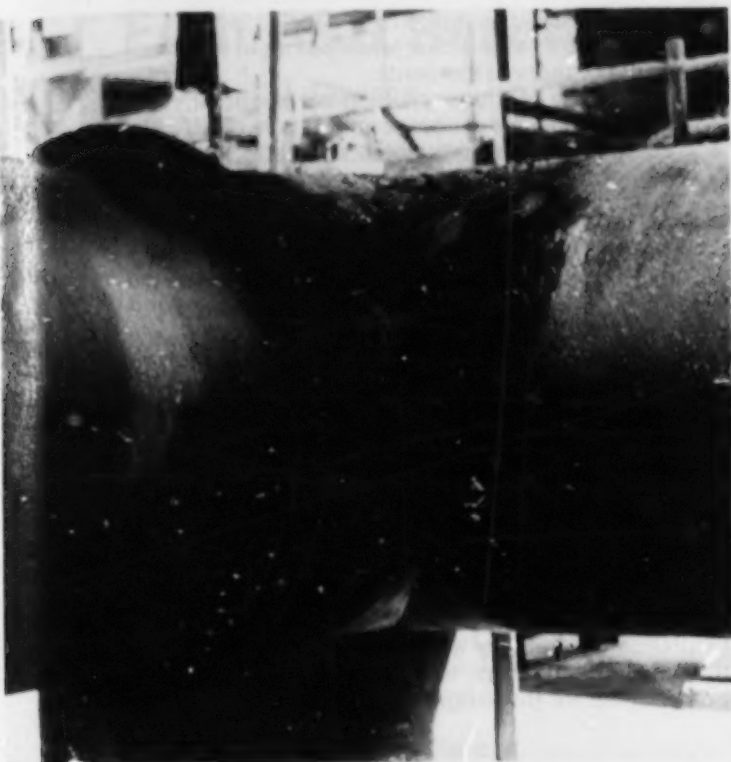
There are several points that need to be made about the recording technique.

Where possible, thermograms should be made within a building. It is easier to evaluate internal thermograms because the transfer of heat is less difficult to determine internally than externally.

All statements regarding the application of thermography in the building industry can also be related to industrial thermal insulation. Worthy of note here is the fact that leaks can be detected in district heating systems with IR-thermography.



Infrared thermography can be used to assess the effectiveness of installed insulation. White areas show excessive conduction losses at pipe hanger. (Photos courtesy of Paul Grover, Infrasppection Institute, Shelburne, VT 05482)



White areas of thermogram indicate excessive heat caused by damaged refractory insulation at corner of this dryer. (Photos courtesy of Paul Grover, Infraspection Institute, Shelburne, VT 05482)

Measuring Conditions

In the main, the following conditions must prevail in building thermography. From these conditions, we can derive further prerequisites for other areas as well.

- The building structure to be examined should be subject to a temperature drop of at least 10°C; i.e., if the room temperature is 20°C, the maximum outside temperature should be 10°C.
- The wind velocity is not to exceed 5 m/s.
- During the measurements, the surface to be examined should not be subject to any solar radiation.
- Only slight fluctuations in building temperature are permitted prior to measurement, and they are not to exceed 2°C, either internally or externally during the actual measurement.

All these important prerequisites for the measurement operation are to be duly recorded.

Infrared Measuring Instruments

Today, we differentiate among three measuring methods:

- *Punctiform.*—Is contactless measurement of object temperatures with light, portable measuring devices for point-for-point scanning of the object to be examined. The resultant information is quantitative.
- *Qualitative infrared sensing systems.*—Produce thermal images corresponding to the temperature distribution on the surface of the object under observation. The resultant information is qualitative; it does not allow any quantitative statements to be made as to the object temperatures. This qualitative infrared thermography is used for the supervision, control, and maintenance of various processes and conditions.
- *Quantitative infrared thermography.*—Permits statements to be made as to the relative or absolute temperatures at any position of the surface of the examined object. The evaluation by means of microcomputer and suitable software permits the thermogram to be shown in colour on a display screen and recorded digitally on data.

In numerous cases, qualitative thermography enables the causes of disturbing symptoms to be recognized quickly and reliably. Consequently, the employment of qualitative—and not quantitative—thermography stands clearly in the forefront.

Process Limitations

There are several limiting quantities of a

thermogram:

- The emission behaviour of the object under observation;
- Environmental influences such as temperature, moisture content, and gas content of the ambient air, as well as further thermal radiating objects in the vicinity of the element being examined; and
- Instationary thermal processes, such as those which are common to building insulation.

Using Thermography

With the aid of two examples, I will now show you how persons employed in the insulation industry are confronted with thermography.

1. The works' management of a nuclear power plant observed a continuous increase in temperature amounting to about 5°C in the reactor building the first few years after commissioning. The control devices and measuring instrument were particularly affected by this. The works' management held the opinion that the effect of the thermal insulation provided for the steam-generating plan had deteriorated.

The thermographic recordings showed perfectly insulated surfaces as well as thermal bridges whereby it involved, as usual, thermal bridges that could not be avoided. However, thermography could not provide any concrete evidence that the thermal insulation was insufficient and therefore responsible for the rise in temperature. This is not at all surprising to those who have some thermographic experience, for thermography is not especially suitable for quantitative statements.

In my opinion, the reason for the increase in temperature in the reactor building was the approximately 1 m-thick concrete building structure which insulated better after 5 years because of the following:

After commissioning, the 1 m-thick concrete structure began to dry out; i.e., to dissipate its building moisture. A reduction of 1 percent in the concrete moisture would have resulted in a temperature rise of 1 to 2°C in the reactor building, as was able to be proved mathematically.

2. A central store with deep storage facilities and insulated with pre-fabricated materials was examined thermographically in accordance with the work contract.

The following extracts have been made from the measurement report:

- The building envelope, except in a few cases, exhibits a very homogeneous surface

temperature distribution.

- There are no significant weak points in the joints of thermal elements.
- In the area of the foundation connections, slight increases in temperature have been established. These are attributable to the higher temperature of the concrete resulting from thermal inertia caused by solar influence.
- All the roof connections exhibit higher temperatures due to the localization of heat in the roof plenum.
- All the doors are generally of homogeneous construction, corresponding entries have been made in the measurement report where weak points have been localized in the door-leaf fillings.

All these statements are qualitative and thermography is a suitable means for such investigations. But the measurement and evaluation may only be carried out by specialists, who must be able to correctly interpret the hot-spots on the thermograms.

Insulation contractors will have no difficulty in recognizing numerous, further application possibilities for thermography.

Conclusions

I will summarize my personal knowledge briefly in four sentences:

1. Thermography can be a time and cost saving aid if it is employed in an expedient manner.
2. Quantitative thermography is possible, but it (still) involves a great deal of effort and expense.
3. Thermograms with exact temperature markings should be treated with skepticism because it is always questionable whether all the influential factors have been determined in a sufficiently exact manner.
4. Qualitative thermography is a valuable tool for the supervision and control of diverse conditions in the insulation industry to determine thermal bridges, dampness, joints, and irregularities.

Walter Baumann is Technical Manager for Schneider & Co.

Chief Engineer's Comments

This article shows but one use of thermography. The Seventh District, among others, has had great success in utilizing the technique for electrical and mechanical troubleshooting. The Naval Engineering Manual (COMDTINST M9000.6) notes the usefulness of thermography as a diagnostic tool in chapter 300.2.2. Infrared thermographic inspection is a proven preventative maintenance tool. Certainly, it should not be considered as high tech experimentation. Applications seem to be limited only by one's imagination. If you have developed a test procedure utilizing thermography, let the rest of the fleet know (through the editor). We can all benefit from your ideas.

Fifth R&D Reader's Digest, Part II

By CDR R. J. Davison
Planning Staff
Eleventh Coast Guard District
Long Beach, California

The Fifth R&D Reader's Digest (Part II) continues a series that began in the Winter 1982 issue of the **Engineer's Digest** (Volume 21, Number 213). Each article is a collection of summaries of recent reports of Coast Guard research and development (R&D) projects. Because every R&D project is documented by a final—and often an interim—report, these articles can be used as a "reader's digest" of what is taking place in the Coast Guard's R&D program.

Copies of complete project reports are available from the *National Technical Information Service (NTIS)*, Springfield, VA 22161, except where noted. A limited quantity of some of the reports may be obtained from the Office of R&D. Be sure to specify the appropriate accession and Coast Guard report numbers when ordering.

Recreational Boating Safety

"A Study to Determine the Need for a Standard Limiting the Horsepower of Recreational Boats"
Report No. CG-D-36-83, Accession No. AD-A-152-575

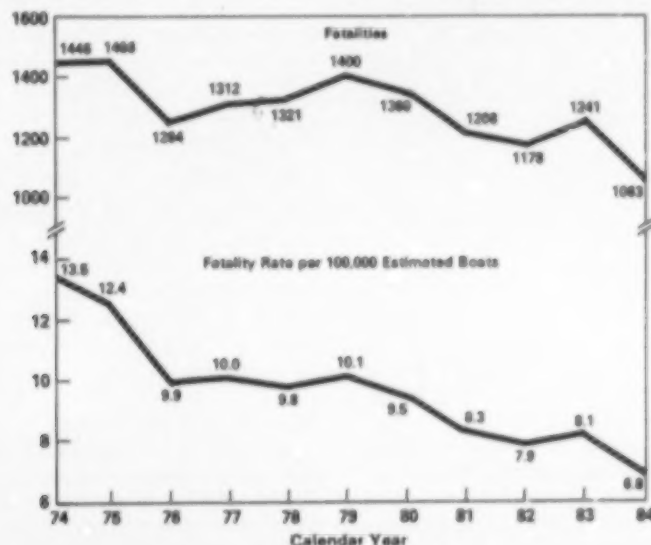
"Development of Alternatives to the Current Safe Powering Standard"
Report No. CG-D-3-85, Accession No. AD-A-153-845

The Federal Boat Safety Act of 1971 (46 USC, Sec.

1451, et seq.) greatly expanded the responsibility and authority of the Coast Guard in the area of recreational boating safety. It authorizes the Coast Guard to establish minimum safety standards for boats and their associated equipment and specifies that each standard must be reasonable, must meet the need for boating safety, and must be stated in terms of performance as far as practicable.

Pursuant to that authority, the Coast Guard (over a period from 1972 to 1975), expended considerable effort in adapting industry standards to a Federal standard. The first—now existing—standard, promulgated by the Coast Guard in 1972, established a safe powering standard for monohull boats less than 20 feet in length powered by outboard motors. The standard was modeled after the then-existing boating industry standard, known as Project H-26, of the American Boat and Yacht Council's (ABYC) "Safety Standards for Small Craft." Project H-26 (Powering of Boats) defines a "formula" and a "test course" method for establishing the maximum horsepower for recreational boats.

Subsequent to the promulgation of the safe powering standard, the Coast Guard continued efforts toward improving it. However, as a result of performance studies and analyses of accident data, further work in this area was suspended,



Recreational boating fatality statistics (1974-1984).

pending the determination of a need for a powering standard and/or the establishment of a more appropriate standard in terms of safety. These two reports document this latter effort.

The first report delineates the efforts undertaken to determine if there is a need for a standard. It shows that a significant number of lives are lost each year because of powering-related accidents and that there is a need for a powering standard. The data indicate that the current standard predicts the high-risk and fatality probability for johnboats, which have high ratios of mounted horsepower divided by formula-rated horsepower, but is not a good predictor for other boat types currently being manufactured. The standard seems to be less effective for newer boats with larger horsepower engines. The report concludes with a list of alternatives to the safe powering standard that need further investigation and with cost/benefit predictions for some of the more viable approaches.

Investigation into alternatives for a safe powering standard are documented in the second report. The report incorporates a literature search for data on the effects of acceleration on unrestrained passengers, a review of mathematical models for small boat maneuvering, a refinement of a large accident data base, a test of boat/engine combinations, and an analysis of investigation results.

The report concludes that an alternative formula using maximum speed and a turn-severity measure derived from the slenderness ratio and hull shape is an accurate predictor of the severity of lateral accelerations for a given boat/engine combination. (Lateral accelerations were found to throw people out of boats in many powering-related accidents.)

In response to the Office of Boating, Public and Consumer Affairs (G-B), the Office of R&D is continuing work on safe powering for recreational boats. Efforts are being directed toward validating the formula documented in the second report against a larger data set.

"Recreational Boating Safety: Analysis for Programmatic Decisions"

Report No. CG-D-9-84, Accession No. AD-A-147-661

In striving for more efficient management of Government programs, managers sometimes face complex and difficult decisions. When judgment, experience, and historical precedents are inadequate, the manager needs help from modern management science techniques. Many of the formal techniques taught in professional business or operations analysis programs are too complex and difficult for routine application by nonspecialists. Some require large amounts of

nonexistent data. The Office of B identified this problem in requesting the Office of R&D to provide a user's guide or supplemental methods relative to an earlier draft manual of elaborate techniques they had been unable to implement. This report is the product of the R&D effort.

The report provides supplemental statistical and decision-analytic methods. The decision aids are multi-attribute utility analysis and formal resource management. Both methods are structured, formal, and rigorous. They can be used with any level of data available, substituting expert/manager estimates and subjective probabilities for any required data that is not available in an objective form.

The report is designed to be read and understood by all levels of recreational boating safety personnel—analysts, managers, and decisionmakers alike. It is designed to increase the awareness of personnel concerning the analytic techniques available to support their mission and to facilitate, through clarification and example, the use of those techniques.

The examples, prepared in terms of recreational boating safety program analysis problems, refer to a prior draft report that is not generally available. Nonetheless, the methods described can be applied to any program. With more adaptation, they can be applied to other types of decision problems. A general programmatic decision framework is outlined: needs assessment, performance prediction, performance evaluation, and resource allocation. Application requires some formal training in management, financial, or economic analysis. Professional training in operations analysis or management science is not essential.

"Investigation of the Use of Drogues to Improve the Safety of Sailing Yachts and Life Rafts"

Report No. CG-D-37-84 (Accession No. not yet available. Contact G-DMT-1, 267-0857, for assistance.)

A major hazard to small craft and life rafts is a large, breaking wave. It can, and too often does, cause capsizing, structural damage, and loss of life. The history of breaking-wave capsizings in the ocean regions of the world where severe storms are encountered is long and continuing, and a great number of boat types and designs are susceptible.

A great deal of interest in research regarding capsizing of sailing yachts in rough seas was generated after a severe storm hit the Fastnet Race of 1979. The storm produced a large number of breaking waves. Fifteen lives were lost, and 24 boats were sunk or abandoned, many due to capsizing. Various research efforts, conducted

subsequent to this tragic event, indicate that properly engineered drogues are more effective in capsize prevention than are the stability characteristics of the boat, that there is a need to better understand the forces involved when a boat is hit by a deep-sea breaking wave, and that a practical engineering solution to the small-boat capsize problem may be possible.

This report documents initial Coast Guard R&D efforts regarding design and use of drogues. This initial effort centered on model testing to further clarify the hazard of capsize by a breaking wave. The models, built to a scale of 1-32, were weighted to give the proper dynamic characteristics and were subjected to two methods of breaking-wave simulation: a horizontal jet of water discharged at the model and a breaking wave formed by the wake of a towed boat. In addition, a mathematical model was prepared to simulate a boat-drogue system in both nonbreaking and breaking waves.

The results of the tests strongly suggest that, for sailing yachts in the 30- to 50-foot range, the hazard of a breaking-wave capsize can be greatly reduced and possibly eliminated by the use of a properly engineered drogue together with relatively moderate changes in boat design, that the dynamics of the boat-drogue system are complex and there is a potential of generating very high loads in the drogue towline, and that current drogue designs may not be satisfactory.

The Office of R&D is continuing its investigation with drogue model tests to obtain qualitative behavior characteristics such as fouling and surface broachings and quantitative measurements of drag. This work will be followed by further drogue/vessel model tests in open water, computer model development to aid in drogue design, and a full-scale demonstration of drogue/vessel theory developed by the previous work.

Marine Environmental Response

"Feasibility Studies for Identification of Santa Barbara Natural Seep and Platform Oils"
Report No. CG-D-28-84 (Accession No. not yet available. Contact G-DMT-3, 267-0851, for assistance.)

This report documents an in-depth study of the chemical profiles of oil samples taken from natural seeps and production platforms in the Santa Barbara Channel. The objective of the study was to develop a capability to identify an oil spill source (seep or specific well) in the Santa Barbara area.

Analyses show that oils from natural seeps can be distinguished from wells by any of several instrumental analytical methods. This finding is most satisfying in that it points to an effective tool for pollution investigations to distinguish between oil spills caused by natural seepage and those that result from industrial accidents or human error.

Typical capsize.





Chart of Upper Mississippi River study area.

provide only the minimal river dredging needed for safe navigation. In recent years, industry and Government have been uncertain whether the dredging permitted was adequate. Some sections of the Upper Mississippi River do not meet the modern engineering criteria developed after the original channels were in place.

In a cooperative effort funded by the Corps' Waterway Experiment Station (WES) in Vicksburg, MS, the Office of R&D and the Office of Marine Environment and Systems did an experimental study on the Coast Guard maneuvering simulator at Coast Guard Headquarters, Washington, DC. These reports document this study.

In the study, the controlling scenario was a condition of relatively high flow in low water conditions in a winding river section near Wabasha, MN. Active professional river pilots made repeated runs through the area in alternative simulated channel widths and depths. Both subjective and objective data were analyzed. The simulation was judged to be realistic and accurate enough to support the study objectives.

The study concluded that a significant improvement in operating safety could be achieved by maintaining a minimum 400-foot channel width in bends, even with no change to the criterion for minimum maintained depth (11 feet). No change in authorization would be needed for such a change

in maintenance dredging policy. Increasing width but not depth would provide the safety benefit with minimal additional dredging, but it would not contribute to towboat operational efficiency. Increasing both depth and width would allow faster speeds as well as safer navigation but at a cost of substantially greater dredging. Changing dredged depth without widening the channel would provide no safety benefit in the river section studied.

Conduct of this study added to the capabilities of the Coast Guard maneuvering simulator and the nearly identical simulator at WES. Simulators have been shown to be efficient and effective devices for harbor and waterway design studies and studies of the practical controllability of vessels, as well as efficient trainers.

About the Author

CDR Davison is currently assigned as planning officer at the Eleventh District, Long Beach, CA. Prior to this assignment, he was assigned to the technical assessment staff (G-DT), Office of Research and Development (R&D). CDR Davison attended the Naval Postgraduate School, Monterey, CA, where he received a M.S. degree in operations research. Other assignments include operations officer aboard CGC Midgett; communications officer on CGC Klamath; and duty at both VTS San Francisco and the Thirteenth District RCC, Seattle, WA. CDR Davison is a 1971 graduate of the Officer Candidate School. Prior to joining the Coast Guard, he attended the University of Washington where he received a B.S. degree.

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